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(54) IMPROVEMENTS IN OR RELATING TO  
TUMBLER DRYING APPARATUS

(71) We, RINNAI KABUSHIKI KAISHA, a corporation of Japan, of 2-26 Fukuzumi-cho, Nakagawa-ku, Nagoya-Shi, Aichi-ken, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a tumbler type drying apparatus.

According to the present invention, there is provided a tumbler type drying apparatus including a casing housing heating means and a tumbler drum mounted within the casing and carrying a door for allowing access to the tumbler drum, which casing is airtight, apart from an air intake in the casing itself, the intake being disposed to one side of the drum, which is remote from the heating means, and a drum air inlet connecting the casing to the drum for air heated by the heating means.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:—

Figure 1 is a diagrammatic sectional side view of a tumbler type drying apparatus.

Figure 2 is a diagrammatic sectional view taken along the line II-II of Figure 1.

Figure 3 is an enlarged sectional side view of part of the apparatus shown in Figure 1.

Figure 4 is an enlarged sectional view taken along the line IV-IV in Figure 1, and

Figure 5 is an enlarged sectional side view of another part of the apparatus shown in Figure 1.

Referring to the drawing, the tumbler type drying apparatus shown includes an apparatus casing 1 in which is substantially horizontally mounted a tumbler drum 2.

The drum 2 is provided in an upper part of the casing 1 and heating means, including a combustion chamber 4, a burner 3, for example, a gas burner, and a fan 5, is mounted under the drum 2.

One end of the drum 2 faces an opening 21 in a front surface of the casing 1. The opening 21 is closed by a door 23 carried by the casing 1, the door 23 including apertures to allow air to flow out of the drum and a filter 22 to filter this air.

A control operation member 24 is provided within the casing 1 above the drum 2 and has a control knob 25 which projects from the front surface of the casing 1.

An electric motor 26 is provided to drive the fan 5, which is mounted on an output shaft of the motor 26 and is also provided to rotate the drum 2 by means of a belt 27 which passes around the output shaft of the motor 26 and the outer wall of the drum 2.

The drum 2 and casing 1 are of such dimensions that a space 20 is provided either side of the drum between the drum and the side walls of the casing 1.

Figure 3 shows more clearly that one end 6 of the drum, which is mounted on roller or ball bearings 9, is in sealing engagement with the front of the casing 1. For this purpose, a front plate 7 of the casing 1 has screwed thereto by screws 9c a flared, hollow ring 9b which defines the opening 21. An annular seal member 9a made of synthetic resin, for example, is held between the edge of the rim 6 and the ring 9b. Thus, when the drum rotates the rim 6 rubs against the member 9a.

A housing 28 surrounds the fan 5 and the interior of the housing 28 is divided into an air mixing chamber 30 to mix air which has not been heated by the burner 3 and air heated by the burner 3 together to obtain a desired temperature of air to be

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passed into the drum 2, and an air supply chamber 29 in communication with the chamber 30, in which chamber 29 the air coming from the chamber 30 is compressed 5 by the fan 5 and fed under pressure towards the drum 2. The upstream side of the chamber 30 has an opening 14 through which can be drawn unheated air from within the casing 1 and a duct 15 leading 10 from the combustion chamber 4.

It will be seen that during operation of the apparatus, air is drawn into the upper part of the casing 1 above the drum 2 through an air intake comprising a plurality 15 of apertures 19. The air is drawn through the spaces 20 past the drum 2 and some of the air is drawn through an aperture 4a into the combustion chamber 4 and is heated by the burner 3, which is then drawn along the duct 15 to the mixing chamber 30. The remainder of the air drawn through the air intake passes around the outside of the combustion chamber 4 and enters the mixing chamber 25 30 through the opening 14. Means are provided to adjust the respective flows of heated and unheated air into the chamber 30 so that the air for the tumbler drum is at a desired temperature.

An air duct 16 is in communication with the chamber 29 to convey the hot air at the desired temperature from the downstream side of the fan to the drum 2 via an intermediate chamber 18 and a drum 35 air inlet constituted by openings 17 in a rear end wall 10 of the drum 2, the wall 10 forming part of the intermediate chamber 18.

The hot air serves to dry clothes, for example, which are being tumbled in the drum 2 as it rotates. The air is then able to pass out of the front end of the drum through the door 23.

It will be appreciated that, with this arrangement, the air which passes over the outside of the drum 2 serves to cool the drum and its bearings and, in so doing, is itself heated somewhat by the drum so that thermal losses are reduced. In addition, the motor 26, which is shielded 50 from the air heated by the burner 3, has a protection against overheating.

The construction of the apparatus is such that the air passing into the drum 2 is inhibited from leaking back into the casing 1. As is illustrated more clearly in Figure 5, the rear end wall of the drum 2 carries a shaft 11 which is mounted in a ball bearing 13 carried on a rear plate 12 60 in the casing by a nut 13c. The bearing 13 could be some other type of rolling bearing and the means to secure the shaft 11 could be by some means other than the nut 13c. In fact, as shown, the construction is 65 secured by an outer race 13a of the bear-

ing being secured within a depression in the plate 12 and the free end of the shaft 11, which is secured to an inner race 13b of the bearing, can bear against a branch plate secured to and extending on the outside of the plate 12. The inner end of the shaft 11 has a shoulder which can bear against the inner race 13b so that the shaft 11 is mounted without axial play within the bearing 13. 70 75

The rear end wall 10 of the drum 2 has a central circular depression which, at its centre carries the shaft 11 and in which the openings 17 are provided communicating the intermediate chamber 18 80 with the interior of the drum 2.

To provide the required sealing between the rear wall 10 of the drum and the rest of the chamber 18, a curved boundary surface 33 of the depression in the wall 10 is caused to bear against a sealing ring 32 85 which is of curved cross section to correspond to the curve of the surface 33. This sealing ring 32 can be of felt, for example, and is secured along one edge in a circular groove in the plate 12 and is itself able to bear against an annular hollow resilient seat 31 which is also curved in cross section, this seat 31 being concentric of the bearing 13. 90 95

The plate 12 has an opening 34 putting the duct 16 and the chamber 18 into communication with one another.

It will be seen that, as the nut 13c is tightened, the portion of the end wall 10 of the drum is caused to bear against the sealing ring 32 but can slide around it upon rotation of the drum. 100

Reference numeral 13d denotes the ball between the inner and outer races of the bearing 13. 105

With the arrangement described, it will be appreciated that the bearing pressure of the drum 2 against the sealing ring 32 is taken up by the bearing 13 and not by the bearing 9 so that the bearing 9 does not have to be designed to withstand axial thrust forces of the drum 2. 110

It can also be seen that the casing 1 of the drying apparatus is air tight apart from the air intake 19 disposed at the side of the drum 2 remote from the heating means 3 within the casing 1 to heat the air for the interior of the drum 2, and the drum air inlet connecting the casing 1 to the drum 2 for air heated by the heating means 3. 115 120

#### WHAT WE CLAIM IS:—

1. A tumbler type drying apparatus including a casing housing heating means and a tumbler drum mounted within the casing and carrying a door for allowing access to the tumbler drum, which casing is airtight, apart from an air intake in the 125 130

casing itself, the intake being disposed to one side of the drum, which is remote from the heating means, and a drum air inlet connecting the casing to the drum for 5 air heated by the heating means.

2. An apparatus as claimed in claim 1, wherein said tumbler drum is mounted substantially horizontally within said casing.

10 3. An apparatus as claimed in claim 1 or 2, wherein said heating means includes a combustion chamber containing a burner.

4. An apparatus as claimed in claim 3, wherein an air duct leads from said combustion chamber, via an air mixing chamber, to a chamber containing a fan.

5. An apparatus as claimed in claim 4, wherein said air mixing chamber has an air inlet through which can be drawn air 20 which has not passed through said combustion chamber and thereby remains unheated so that the temperature of the air for the drum can be regulated.

6. An apparatus as claimed in any one of the preceding claims, wherein one end of said tumbler drum is open and is in rotatable engagement within an opening in one surface of said casing by means of bearings, this end of said drum bearing 30 against a sealing member to seal this end of the drum with respect to the interior of said casing.

7. An apparatus as claimed in claim 6, wherein the other end of said tumbler drum carries a central shaft rotatably mounted in a bearing in a rear plate in said casing.

8. An apparatus as claimed in claim 6 or 7, wherein the other end of said drum has an end wall with said air inlet in it, this inlet being constituted by openings through which air from said heating means can pass into the interior of said drum.

9. An apparatus as claimed in claim 6, 45 7 or 8, wherein said door is for closing the open end of said tumbler drum and has apertures in it to allow air to pass out of the drum.

10. An apparatus as claimed in claims 50 4 and 8, with or without claim 9 wherein said chamber containing said fan is in communication with a duct on the downstream side of said fan, this duct leading to an intermediate chamber of which said 55 end wall of said tumbler drum forms a

part, the remaining part of said intermediate chamber being in sealing engagement with said end wall of said drum.

11. An apparatus as claimed in claim 7 or 10 or claim 8 or 9 as appendant to claim 7, wherein the bearing which is associated with said shaft is a roller bearing having an outer race secured in said casing and an inner race secured to said shaft.

12. An apparatus as claimed in claims 65 7, 8 and 10, with or without claim 9 or 11, wherein the sealing engagement of said drum with said intermediate chamber is provided by a circular boundary surface, which is curved in cross section, of a portion of said end wall of said drum being 70 caused to bear against a sealing ring which is correspondingly curved in cross section, this sealing ring being secured and supported by a member secured to said rear 75 plate in said casing.

13. An apparatus as claimed in claim 12, wherein the last mentioned sealing ring is of felt.

14. An apparatus as claimed in any 80 one of the preceding claims, wherein the dimensions of said tumbler drum and said casing are such that a space is provided either side of said drum so that air entering said air intake can pass between the 85 drum and the casing to reach said heating means.

15. A tumbler type drying apparatus, substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings. 90

16. A tumbler type drying apparatus, substantially as hereinbefore described, with reference to Figures 1, 2, 4 and 5 of the accompanying drawings. 95

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FIG. 1

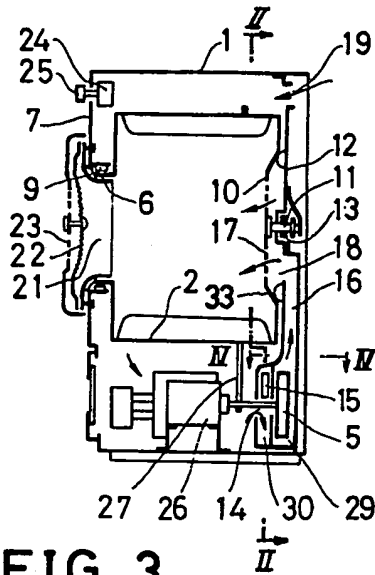


FIG. 2

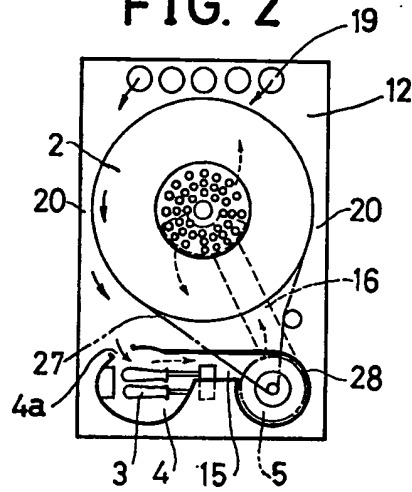


FIG. 3

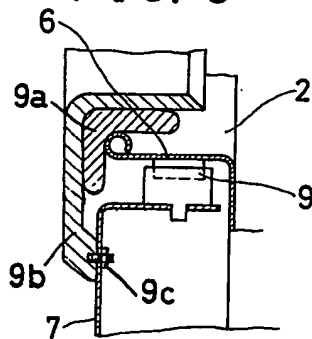


FIG. 4

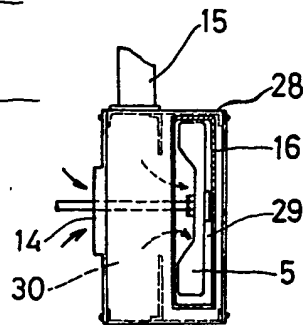


FIG. 5

